

A Complexity Response to Funding Public Education

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Abstract

Financing public education and assuring compliance in terms of achievement, accountability and access is a challenge both for governmental entities and school districts. Tying the federal dollar to criteria for academic progress yielded many reforms in public education, such as No Child Left Behind (NCLB). Unfortunately, these reforms failed to achieve their intended goals because of their linear approach toward problem-solving. Treating the financing of public education from a complexity perspective and utilizing approaches such as the Agent-Based Model not only would uncover the fallacies of the linear approaches but also offer new directions and possibilities toward progress that can utilize autonomy, interconnectedness, mutual causality, and shared responsiveness.

This article briefly examines the state of public education in the United States from the early 1700s until today, the major challenges that face public education, NCLB and its shortcoming as the latest reform in financing public education, and then offers a complexity approach to solving this problem.

Keywords: Public Education, Public Budgeting, Agent-Based Model, Autonomy, Complex Adaptive System.

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Introduction

When No Child Left Behind (NCLB) was unveiled to the public in January 2002, the cost of administering such a program was an area of concern for politicians, school administrators, teachers, and parents. Six years later, the lingering area of contention still revolves around the designated federal funds allocated for this program.

Under current guidelines and requirements of NCLB, the federal funding allocations to individual states, districts and campuses are essentially a performance-based reward program. Campuses, districts and states which continue to meet performance expectations will continue to receive allocated funds. Schools that repeatedly do not meet performance standards will see funding withheld. While performance has become a primary criterion for the continuous funding at the local district and state levels, what happens to schools and districts when the federal government fails to meet promised allocations is of utmost concern. This paper will explore the patterns of NCLB funding since 2002 while evaluating the unintended consequences that states, districts and schools experience when a federal policy impedes on a system whose administration has historically been left to that of the school and state levels. I will then explore the issue of funding public education from a complexity science perspective and outline the differences with a linear approach towards budgeting. The aim is to entertain a more complex, interactive and dynamic approach to funding public policies.

The Development of the United States Education System

Historically the education of the citizenry of the United States has been left to the citizens. Public and private schools have been surfacing in towns and communities to provide education to the public. In April 1635, Boston Latin School opened as the first public school in the colonies to educate the youth in Latin and Greek and philosophical debate (Boston Latin School, 2006: 1). The second school, named for its first benefactor John Harvard, was instituted to help maintain an educated class of clergy (Harvard College, 2005:1). In 1642, the first large-scale publicly enacted education law was developed in Massachusetts. The act mandated that all parents and “masters” educate their children to a level where they could read, comprehend and apply the understandings of the Bible (Jernigan, 1981:78).

By the 1700s, education shifted from the teaching of religion to that of civics, math and science. Schools were no longer ear-marked only for training and developing of clergymen, but also to aid in the development of communities to become self-sufficient (Barger, 2004, pp.23-29). In 1785, the Land Ordinance helped establish specific tracts of land in each newly developed community, in which each sixteenth section of each township was set aside for the maintenance of public schools (Ohio Historical Society, 2008: 1).

Progress of regional development of public education continued throughout the next two centuries, eventually incorporating women and minorities into the ranks of an educated society as well. However, as the population began to expand, state and local governments started to feel the economic impact of funding public education. While the federal government has helped to expand public education through policy development and legislations, such as the Land Grant Acts of the 1800s and the Civil Rights and Equality Acts of the 1900s, little has been established in the way of a universal policy which mandated and regulated public school funding. Resources

to successfully administer public education were derived from three areas: federal funding; state funding; and local funding with property tax as the highest resource of funding for the local level (Barger, 2004). In 2006 the United States Census Bureau identified that 9% of public school funding was provided by the federal government while 47% was received from states, and 44% of funding was supported from local taxation (U.S. Census, 2006: 38).

In 1965, Congress passed the Elementary and Secondary Education Act in order to set parameters for funding public education. States continued to have flexibility in determining educational outcomes and funding distribution policies. In 1979 President Carter created the Department of Education to assist in distribution of funding and to ensure equality of civil rights and opportunity to all students receiving federal funds. Political resistance from the Reagan Administration led to little interference in local public education during the 1980s and 1990s. It was not until 2002 that the federal government cascaded into local public school systems through a series of requirements, measures and checks creating what many have considered to be a backwards step in regard to rewards systems by focusing on detrimental consequences for not meeting expectations. This is the policy known as “No Child Left Behind” (Mathis, 2003: 679).

Creating the solution or compounding the problem?

The process and administration of a *federal* bureaucracy for education has had the effect of increasing expenditures at the state level, a result compounded by the passage of NCLB. The Heritage Foundation estimated that 41% of individual states’ resources are expended on the administration of federal funds and policies governing public education, funds that encompass 7% to 9% of total revenue to the states and localities (Lips and Feinberg, 2007: 1). The Office of Management and Budget calculates that a \$141 million expenditure has been imposed on the states to comply with NCLB policies (Executive Office of the President, 2008: 1). Some states have either already begun to or are approaching a situation where local state expenditures for compliance with NCLB standards surpass the actual amount of annually allocated funding (Lecker, 2004: 1; O’Marah and Rebarber, 2004: 21-32). Since 2002, the federal government has allocated only \$166 billion of a promised \$237 billion of the NCLB budget (Marks, 2005: 1). The difference between promised and realized funds has exceeded \$70.9 billion. However, standards of student and school improvement which determine eligibility for future funding continue to increase at the expense of states and localities (Mathis, 2003: 680). Uncompensated increases include teacher compensation for mandatory tutoring of low-performing students, absorbing the cost of transporting students to a school of their choice, raising professionals and paraprofessionals to the level of “high quality,” general operational expenses of an increased school day and numerous intervention strategies to reduce drop-out rates or improve graduation and attendance rates (NEA, 2004: 1). The perceived ad-lib style caveats that determine eligibility for funding and compliance annually, coupled with 35% disparities between promised and allocated funds, has significantly damaged the usefulness of NCLB (Marks, 2005: 6). Figure 1 illustrates the circular logic of NCLB that leads from one failed situation to another. When a school district is performing low due to lack of funding, teaching and technical capacities or curriculum (as in Stage 1), NCLP penalizes this district for such a failure and federal funding is withheld (as in Stage 2) until performance is improved. To meet such a challenge, school districts rely on local funding to improve performance (as in Stage 3), but when local funding is not capable of meeting the demands of improving public education or NCLB requirements, performance further declines (as in Stage 4), a condition that leads to further decrease in future

federal funding (as in Stage 5), up to shutting down the targeted low performing schools.

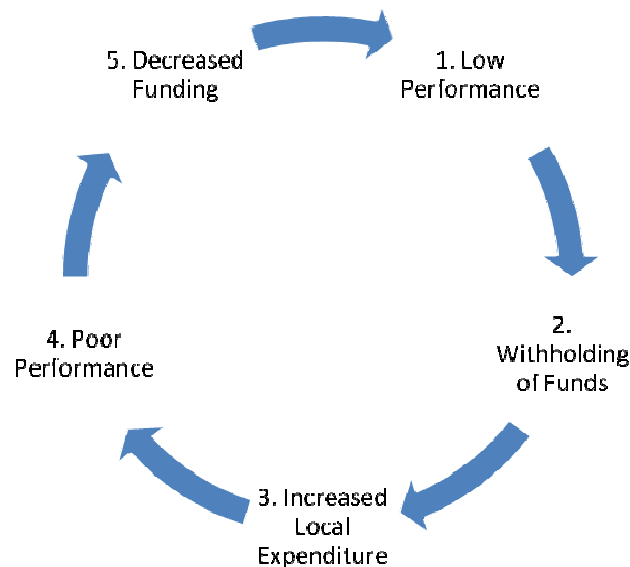


Figure 1: NCLB Circular Logic

Taking the Good with the Bad

Attempting to add a sense of accountability into the national education system, the current day NCLB policy has created a multi-tiered system of federal funding in which more funds are allocated to those areas of greater need. However, these areas are often the same areas with the least resources and with statistically lower levels of success and accomplishment. The catch 22 that has developed under NCLB is the temptation of funding by the federal government to improve performance while countering by the threat of withholding funding for not meeting the established levels of performance increase. While many schools and districts are trying to keep up with the education requirements, a new battle of compliance has developed. With states surpassing their expected federal funds to maintain compliance or the funding policy, one needs to wonder how long these states will continue to tolerate the policies that produce these funds, especially when they manifest into numerous unexpected complications.

NCLB judges students and educators based solely on standardized test scores at the expense of critical and higher order thinking. The law's focus on testing, without providing basic resources, has even narrowed the curriculum. Education funding policy needs a new direction. The federal government needs to embrace its role as a supporter, not a manager of state and district responsibility. It can do so by strengthening the enforcement of civil rights laws to promote access and opportunity and help create the capacity at the local and state levels for school transformation (NEA, 2008: 1). The federal government has a critical role in public education by emphasizing equity, opportunity and targeted assistance to underserved communities. At the same time, it must respect the role of state and school districts as the primary provider of education services.

Complexity and Funding Public Education

Wall Street Journal columnist Gerald Seib noted, “A political system that expects failure doesn’t try very hard to produce anything else” (Seib, 2008: 1). The funding of public education, like any other public program, must be recognized as a political process. Budgets are political documents (Wildavsky, 1980: 16). For a budgetary process to work, incremental measures should be taken by the federal government instead of a comprehensive approach (Lindblom, 1959: 8). Whenever the federal government engages in a comprehensive systemic approach, the result often yields unintended consequences. Because of this, budgetary processes have often been measures to avoid failure. Such a mantra is rooted in the linear thinking of public policy.

No Child Left Behind deserves credit for attempting to change the education system comprehensively; however, the unintended consequences of this policy and perhaps even of future comprehensive policies are deeply rooted in the political system itself and in the budgetary process in particular. To shift the dynamic from failure to success, the government must transform its thinking from a linear approach toward a complex systems approach. In order to do so, funding of public projects and programs must encompass a new perspective that is invigorating, adaptive, complex and sensitive to changes in the environment. This new approach needs to encourage autonomous decision making and eliminate the outdated zygote of control single, lineal causality, predictability and the outmoded belief that long-term planning by itself will prove a match to the ostensive unfolding complexity of the educational milieu.

Complexity offers such new directions. It is a perspective that opens up possibilities for consideration of multiple perspectives, unpredictable evolution of social networks and utilization of random changes to create new, unexpected order (Wheatley, 2006: 33). The model that best represents this new approach in funding public education is the Agent-Based Model (Gilbert, 2008: 13). Using this model, the federal government, the states and the school districts would become agents within a matrix and interconnected network. As Figure 2 illustrates, each agent will be autonomous and interact with its environments, other agents and networks. In this nonlinear point of view, each particular agent has the potential of influencing the entire network

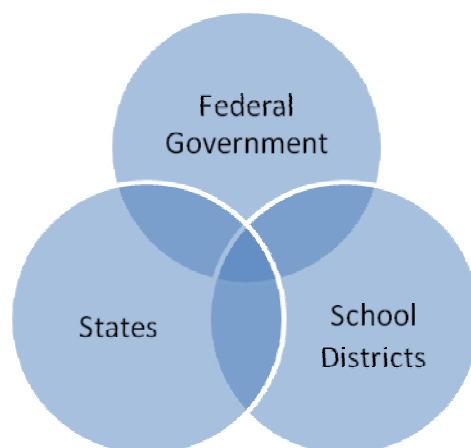


Figure 2: Funding Public Education as an Agent-Based Model

as well as other associated networks, benefiting from the so-called “butterfly effect” in which a single event can be dramatically magnified into an exponentially increasing dynamic. Within this transformation, both the agent and the network will go through self-reorganization and restructuring in order to cope with the changes in the environment (Goldstein, 1994).

The relationship between the agent and the environment will operate on the basis of mutual causality, with one factor impacting the other, producing feedbacks that are either positive (more changes in the environment leading to more changes in the system’s structure, and fewer changes in the environment leading to fewer changes in the system’s structure) or negative (a change in the environment initiates a change in the opposite direction within the system’s structure, with more changes in the environment leading to fewer changes in the structure and fewer changes in the environment leading to more changes in the system’s structure) and vice versa (Morgan, 1986: 137). Since the “kick” in the environment is unpredictable, the changes associated with it in the agent can be experienced as random, yet containing the possibility of morphing the agent’s structure from static equilibrium to a state of chaos and disorder with the potential for self-organizing into innovative new structures and practices (Prigogine, 1996, pp. 32-34).

Hence, out of seeming “chaos” new structures can emerge that are sustainable since they are a better fit with the changing conditions in the environment. Any particular state of equilibrium or stability are not permanent but continue to shift as new unexpected perturbations in the environment create a new *dis-shuffling* of the structural order moves it toward phase shifts that produce a new equilibrium (Strogatz, 2001: 181). Because of this dynamic association between the agent and the environment, the structure will always be able to reorganize itself and produce something new that can thrive more effectively under new conditions (Waldrop, 1992: 217-237). However, for this dynamic to work, the agent must be autonomous and must be interconnected with other agents within a network of association that is flexible, is more unrestricted, and possesses a greater resiliency in the face of change (Gilbert, 2008: 21). This means the entire network of connected agents and environments form a *complex adaptive system* with a capacity for ongoing adaptations to environmental changes (Miller and Page, 2007: 237). If the system is not operating in such a complex and adaptive manner, it will either die completely or result in an unwanted worse state of affairs (Holland, 1998: 112-113). Figure 3 demonstrates such a dynamic. It illustrates the interconnectedness of a complex system that morphs from one stage to another, transforming within each stage into different evolutionary phases that is self-organized and adaptive to changes in the environment. These phases are also circular, moving in a constant state of change from equilibrium to disequilibrium to equilibrium to disequilibrium and so forth. The primary phases of these self-organizing stages starts at random from awareness of the environmental changes as a stage one, morphing to an analysis of the system’s structure in stage two, leading to the transformation of the system in stage three in order to correspond with changes in the environment, and then progressing to suitability of the complex system for a limited period of equilibrium until another kick in the environment forces a new set of changes, leading the complex system once again to go through the same self-organizing dynamic of awareness, analysis, transformation and sustainability.

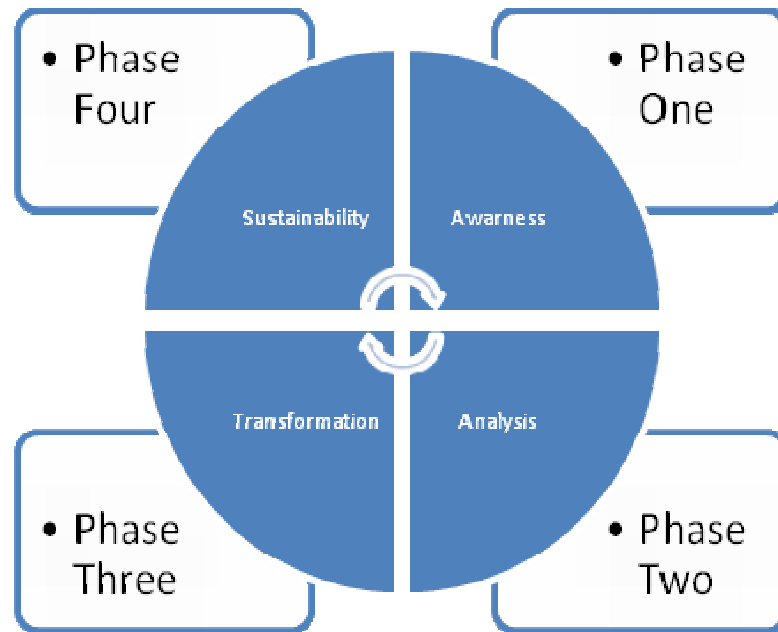


Figure 3: Complex Adaptive System

Funding public education is better thought of as a complex adaptive system along the lines of scenario described above. In order for public education to live within a continually changing environment, it must act (and be funded) as a dynamically adapting system. This complex system is composed of many interacting and autonomous agents residing in the federal government, the states, as well as the local school districts. Each agent is associated with others as partners. In such a scheme, no single agent is posited as in a position of control or centralized decision-making. Instead, the autonomy and networked nature of the associations among the agents make possible a continuing transformation of internal structures meshing more suitably with changes in the external structures making up the environment. This complex network is characterized as:

1. Transparent in its operation to those both within and outside observing it;
2. Operating out of mutual causality and influence;
3. Focusing on the present moment where adaptability proceeds and accordingly realizing that long term predictions and planning may drastically alter in the “fog” of battle;
4. Pattern seeking by way of creative disequilibrium and disorganization that enables an ongoing shifting into new structures;
5. Paradoxically preparing for unexpected consequences and uncertain outcomes;
6. Evolving by benefiting from the “butterfly effect”;
7. Self-transcending in the sense of emerging out of the interactions of autonomous agents (Goldstein, 2007);
8. Patterns form out of processes not imposition;
9. Internal structures are permeable to changes in the environment.

In summary, understanding funding for education as a complex systems implies qualities quite different than what a simply system approach to funding what have it, namely, the complexity-based attributes of decentralization, collaboration, readiness for action, informality, and possessing multiple connections with one another within and outside the network.

Conclusion

Newton's laws in physics and the subsequent linear interpretation of the world that came out of it were obviously a tremendous step in progress for human knowledge that unveiled new frontiers and understandings of the world around us, even enabling humans to land on the moon. The Newtonian understanding went way beyond physics as such by shaping the other natural and social sciences. It was the accomplishments of that world-view which led to the undergirding of much of modern decision-making processes, analytical thinking and interpretations of the world (Kauffman, 1993: 23). However, new discoveries in sciences and mathematics have revealed an entire new world understood much better through the constructs of complexity than simplicity and thus have opened our perspective to new dimensions and interpretations that strict linear analysis is incapable of producing (Kiel, 1999: 69). These new findings transcend a narrow focus on linear rationality, singular cause and effect, certainty, predictability, hierarchy, formal organization, centralization and control, even inertia in the face of change.

In public policy and administration the new science of complexity offers new solutions that the old Newtonian science is incapable of entertaining (Morcol and Dennard, 1999: 245). However, because this frontier is so new and despite its already proven success in so many arenas of application, it has not yet been widely accepted or practiced. Nevertheless, now seems to be an opportune moment to relook at the problems within our current political and administrative structures and come up with new solutions.

When viewing funding public education according to the prisms of complexity science, we can now embark on a different perspective that may lead us to new possibilities we did not possess before. Within these possibilities we may be able to respond to the challenges of today and prepare our education system to correspond with changes in its environment. Funding public education as a system has a better possibility for sustainability when observed as an interconnected matrix and web of associations with each unit interacting within it as an autonomous agent, without any one unit exerting control or constraint, with the entire matrix operating as an evolving dynamic system capable of responding quickly and effectively to unforeseen changes in the environment.

The fact is that the world is not linear (Strogatz, 1994: 9). We cannot predict the future, and we live in a constant state of uncertainty ((Prigogine, 1996: 29). Building our education system and its funding solely on an unwarranted belief in predictable, long-term planning is futile at best, and potentially catastrophic. Instead, we have to treat each unit within the education system as an autonomous agent. These agents exert influence on other agents and the system as a whole. With such an understanding, long-term budgeting must be welded to flexible an adaptable short-term budgeting that can adjust according to the unpredictable changes in the environment.

Autonomous agents in interaction with each other have the potential for generating funding in ways that have not previously even been imagine. Moreover, because these agents are embedded in a large network of connections, they can rely on each other and the system of the whole in a manner not thought possible before. Collectively all agents work together in order to operate as one while maneuvering and making decisions as autonomous units. Surplus revenue in a particular unit that is not used due to larger revenues can be allocated to future growth of that particular agent or to support other agents that lack funding. And this process of allocating resources is one that is constantly evolving and adapting to new fiscal constraints and resources.

Policies such as NCLB, for example, will be modified so that funding will no longer be linearly linked to shallow measures of performance as a precondition. Competition for limited funding can be replaced with collaborative problem-solving for sake of promoting one another based on mutual causality. The federal government of course needs to act as a supporting agent in such a network of association in order to facilitate the growth of other agents such as the states and the school districts. Just as local school districts can generate their funding locally through property tax and other sources of revenue, the federal and state governments, understood as heterarchically arranged agents themselves can supplement by providing additional funding based on need. This is a networked emerging complex system that can produce synergies capable of adapting rapidly to changes in the environment. Indeed, the current world-wide economic crisis can be seen as a test site for a new complex systems understanding of the funding of education.

This inevitably brings us to the issue of accountability. Since funding will no longer be tied strictly to only narrow performance measures, other measures for accountability must be enacted in order to assure each agent's autonomous growth as part of the system's overall synergy. In order to establish such accountability for individual autonomous agents, the system itself will be accountable. This means that measures for growth in educational performance have to meet medium parameters established by the system as a whole and emerging within the collaborative efforts of its individual autonomous agents. This medium will not be measured by the current day standards of testing as set by NCLB. Rather it will be the result of evolving new perspectives emerging out of the interaction of individual autonomous agents within the system as a whole. The associations within the network will need to be coordinated towards "pushing" the internal dynamics to generate new parameters for the evaluation of the educational efficacy of our institutions. Agents that prove incapable of meeting the changing parameters will be assessed by the system as a whole in order to uncover the causes for their shortcomings and help them overcome their difficulties. This is how complexity answers the problems of funding public education.

In a world of uncertainty, we can no longer rely on a naïve confidence that long term results can be accurately predicted. Instead, the emphasis needs to shift to a much greater flexibility which prepares any current structure to respond adaptively to unprecedented changes. When changes occur in the environment, we need to have organizations that can allow for changes to take place within their structure even to the degree, sometimes, of collapsing the existing order to make way for the new. This bold and courageous understanding will enable us to let go of our fruitless tenacity to outdated structures and encourage us to embrace change and emergence of the new. Indeed we are finally beginning to recognize that stasis is not what is inevitable but radical, in the etymological sense of "getting to the root," transformation is.

About the Author

Alexander Dawoody is an Assistant Professor of Public Administration at Marymount University. He received his Ph.D. in Public Affairs and Administration from Western Michigan University. He also holds four masters degrees in Philosophy, Health Administration, Public Administration and Education that he received from Western Michigan University, Suffolk University and Cambridge College, respectively. Dr. Dawoody is the author of several books and journal articles on complexity and public policy and has presented numerous research articles on this topic at various professional conferences. He can be reached at adawoody@marywwod.edu

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